CAPSTONE PROJECT – STOCK PRICE ANALYSIS & PORTFOLIO MANAGEMENT

SRIRAM K

INVESTOR PROFILE & OBJECTIVE

Investor : Ms.Alexandra Kolishnyick

Investor Profile : Student, about to get into Ivy League college.

Source of Investment : Saved money throughout the schooling

Investment Goal : To form an NGO, to support the people and their livelihood in the Sub-Saharan Region

Investor's Risk Appetite : Moderate Risk appetite and looking forward for sustained, promised and stable portfolio

Investment Tenure : 2-3 years

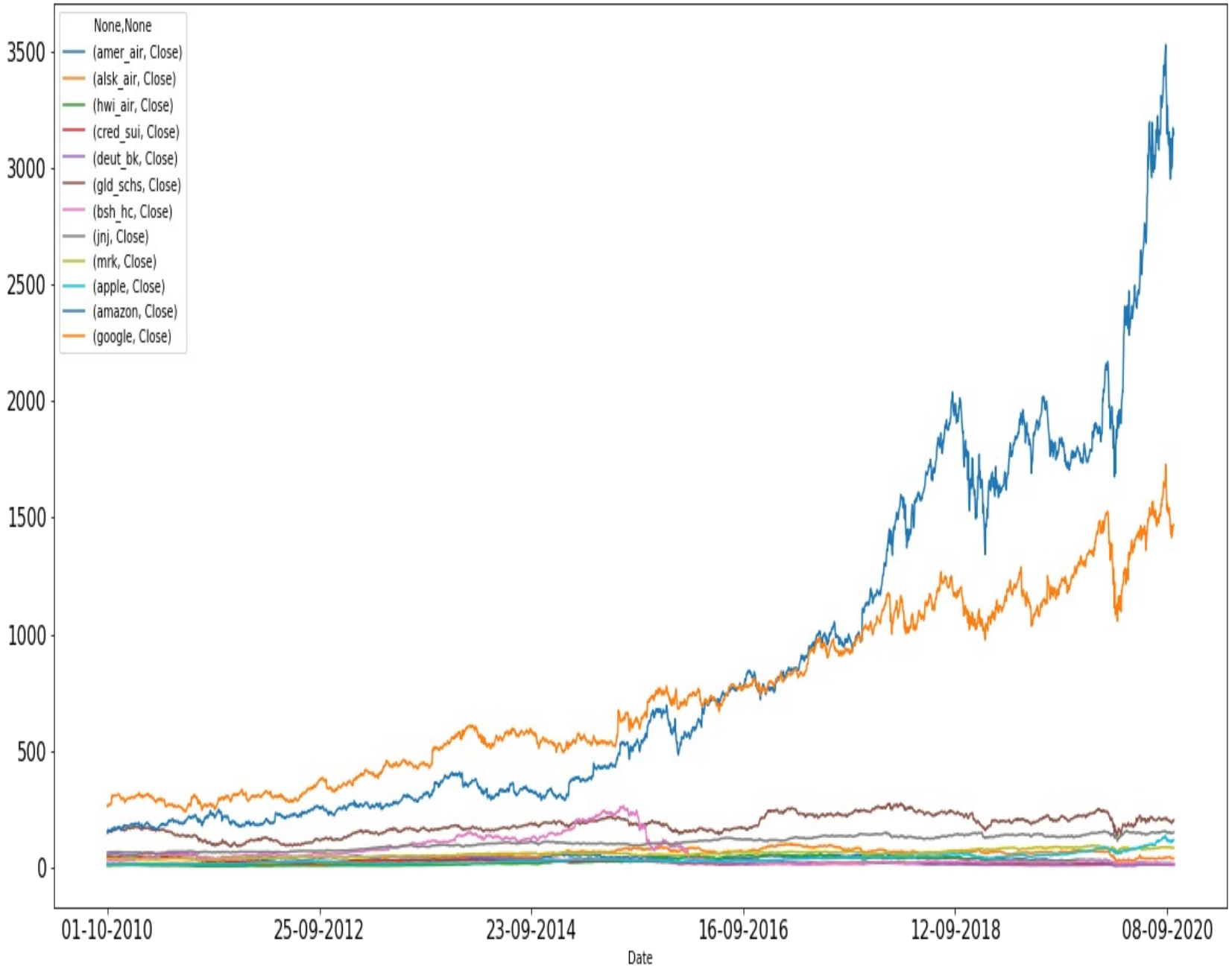
STOCK PRICE ANALYSIS

- 12 Stocks of companies from 4 different Industries (Aviation, Banking, Healthcare & Technology) were chosen for this analysis
- The Minimum and Maximum Price of the Stocks are shown in the right
- As shown the Prices of the Stock varies from price around as low as $4 / stock (American Airlines) to $3531(Amazon)
- The price trend and performance of the Stocks for analysis have been chosen for a period of almost 10 years (Jan'10 – Sept19)

Stock	Minimum Price	Maximum Price
American Airlines	4.000000	58.470001
Alaskan Airlines	11.620000	100.239998
Hawaiian Airlines	3.780000	60.299999
Credit Suisse	6.670000	46.513672
Deutsche Bank	5.480000	62.624046
Goldman Sachs	87.699997	273.380005
Bausch HC	8.510000	262.519989
ohnson n Johnson	57.660000	155.509995
Marck	29.809999	92.040001
Apple	9.951428	134.179993
Amazon	153.029999	3531.449951
Google	236.553345	1728.280029

10 YEAR CLOSING PRICE TREND

- Stock price of Amazon and has grown from a Closing price range of less than $150 to $3500 – 2233% Growth
- Stock price of another Tech giant Google has grown from $230 to $1700 – 632% Growth
- The closing price of Other stocks haven't grown to such a huge extent and have remained within price range of $500



		mean	std	Mean	Standard Deviation / Volatility
amer_air	Close	29.397636	15.211889	7378.806657	241.001650
alsk_air	Close	50.031176	24.187020	12557.825189	383.194456
hwi_air	Close	22.870413	15.483034	5740.473709	245.297395
cred_sui	Close	21.501379	8.988043	5396.846157	142.397378
deut_bk	Close	27.304930	15.409974	6853.537508	244.139903
gld_schs	Close	179.598184	42.405475	45079.144293	671.829069
bsh_hc	Close	61.880687	57.170002	15532.052531	905.743173
jnj	Close	105.277378	28.174233	26424.621831	446.363801
mrk	Close	57.161053	15.164505	14347.424268	240.250946
apple	Close	33.454670	20.630118	8397.122224	326.842540
amazon	Close	854.636107	745.201139	214513.662800	11806.206375
google	Close	730.426139	364.685720	183336.960946	5777.708389

STOCK PRICE STAT - VOLATILITY

- Volatility represents how large an asset's prices swing around the mean price—it is a statistical measure of its dispersion of returns.
- Volatility can be calculated using Variance and Standard Deviation of the Stock
- Since Volatility measure changes over a period, it is calculated with Standard deviation and Square root of the trading days

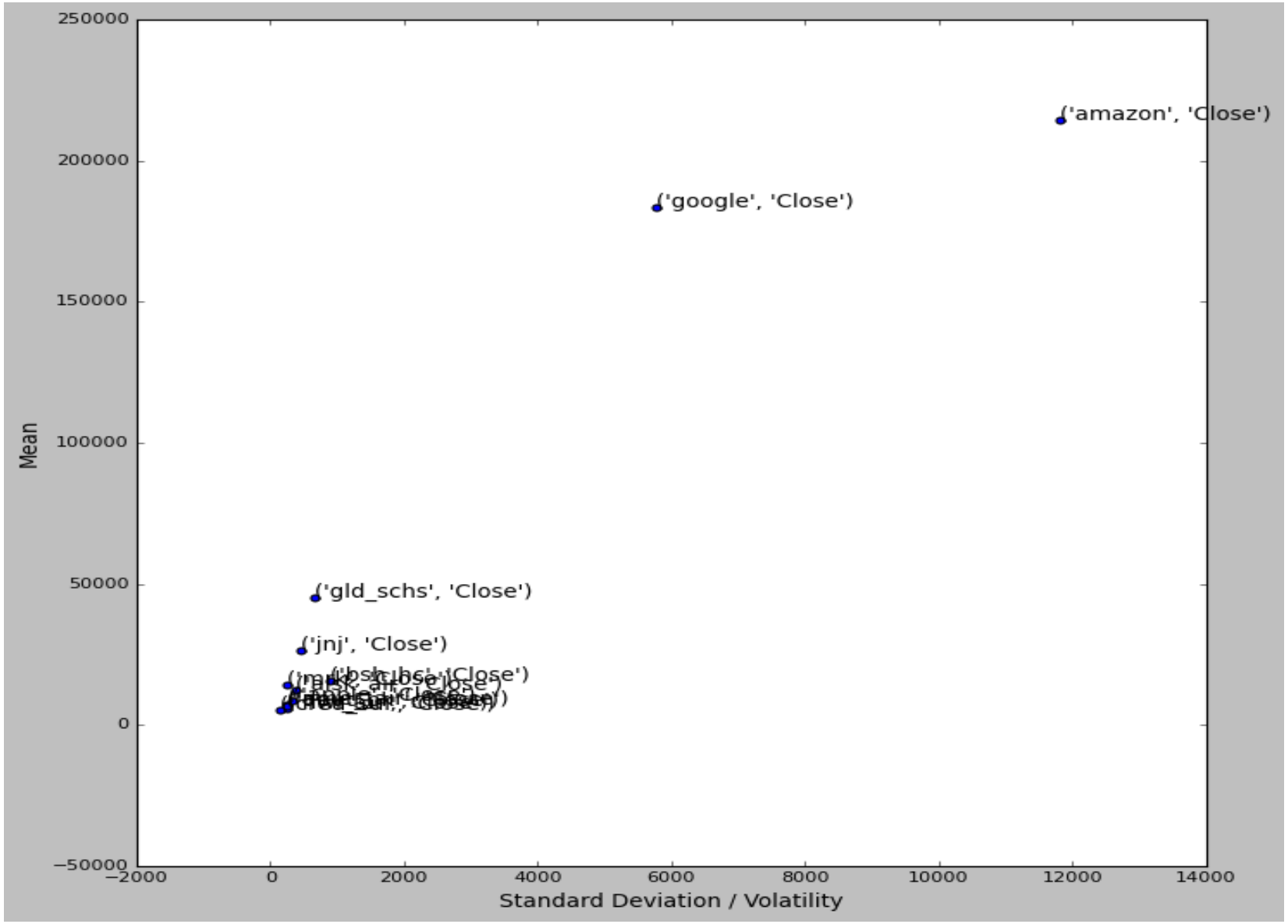
THE VOLATILITY OF STOCKS

- Amazon, Google have grown in a vast scale in the 10-year period, so their Standard Deviation & volatility is high

- Other stocks of Goldman Sachs and Johnson & Johnson are moderately volatile

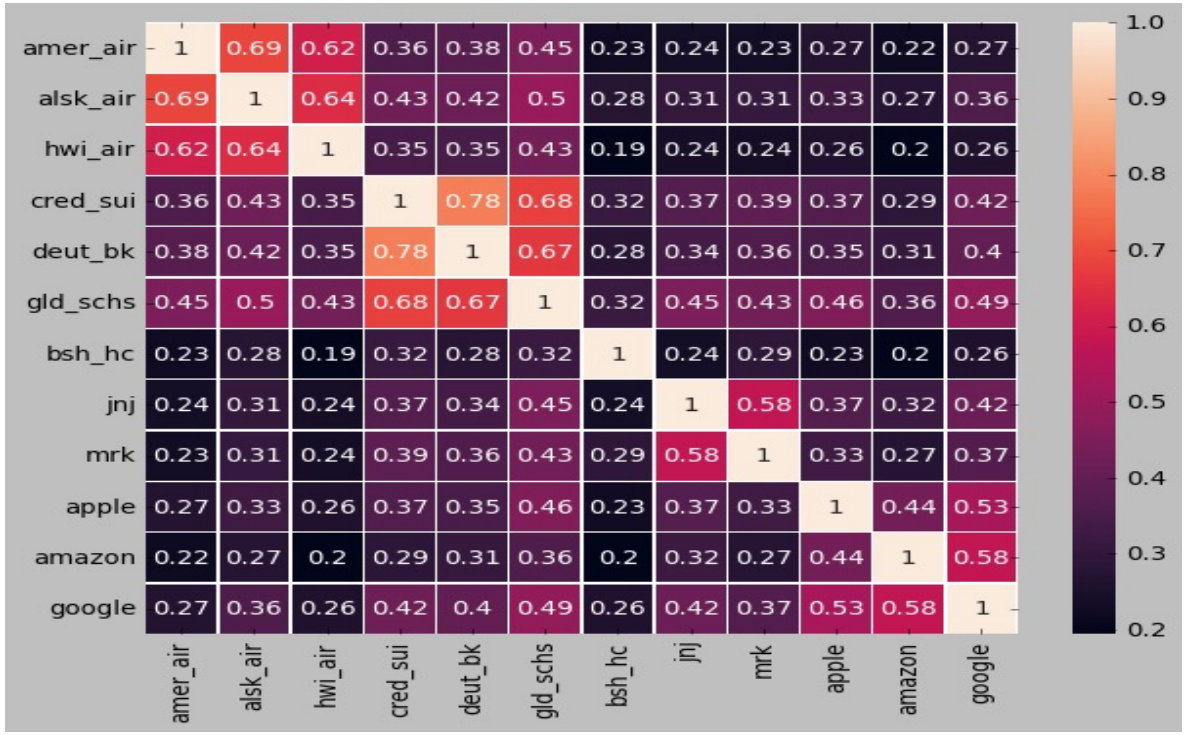
- Remaining 8 Stocks have displayed a low volatility over the same period

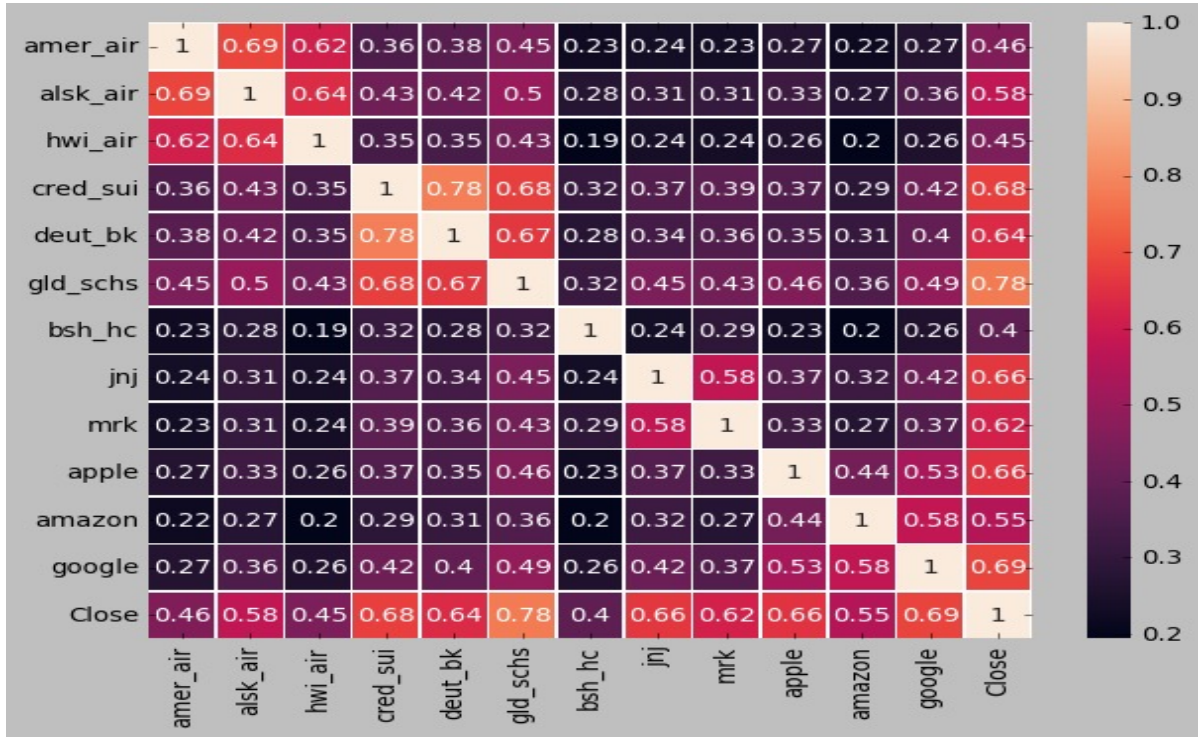
- Volatility is often used to describe risk, but this is necessarily always the case. Risk involves the chances of experiencing a loss, while volatility describes how large and quickly prices move



CORRELATION – WHAT IS IT?

- **Correlation measures association between Stocks but doesn't show if Stock-A affects Stock-B or vice versa**
- **It is a statistic method that measures the degree to which the variables (here the stocks) move in relation to each other**
- **It is used to measure the movement of a stock with that of a Benchmark index (S & P 500)**
- **The values vary between -1 to +1 for eg. -1 Negatively Correlated (Stock A grows, Stock B falls) , +1 Positively Correlated (Stock A grows and Stock B also grows) and 0- No correlation. Same is visualized using a Heat Map**





CORRELATION – CONTINUED..

- **Stocks such as Goldman Sachs, Google, Credit Suisse, Johnson&Johnson, Apple and Deutsche Bank have a High Positive Correlation with the Market Index (Close – S&P 500)**
- **Other stocks have a moderate Positive Correlation with the market index**
- **It is to be clearly noted that all the stocks that are being analysed have a positive correlation with the Market Index, thus it can be safely said that these Stocks move in relation with S&P 500**

CAPITAL ASSET PRICING MODEL (CAPM)

- The capital asset pricing model (CAPM) describes the relationship between the systematic risk and the expected return for assets and is mainly used for stocks.

- CAPM tries to capture this investment risk and the amount of return that an investor should expect on the investment.

- Through CAPM we calculate the Expected return using the Risk – free Return adding it to the weighted difference between Market Returns & Risk – free Return

$$R_a = R_{rf} + \beta_a * (R_m - R_{rf})$$

where:

$R_a = \text{Expected return on a security}$

$R_{rf} = \text{Risk-free rate}$

$R_m = \text{Expected return of the market}$

$\beta_a = \text{The beta of the security}$

$(R_m - R_{rf}) = \text{Equity market premium}$

Risk-free rate – US. Treasury Bonds Return rate of 10 years – 0.75%

Market Return % - The returns of Standard & Poor 500 since 2010 is taken as – 14.7%

BETA VALUE – WHAT IS IT?

- Beta is a measure of a stock's volatility in relation to the overall market. By definition, the market, such as the S&P 500 Index, has a beta of 1.0, and individual stocks are ranked according to how much they deviate from the market.

- A stock that swings more than the market over time has a beta above 1.0. If a stock moves less than the market, the stock's beta is less than 1.0. High-beta stocks are supposed to be riskier but provide higher return potential; low-beta stocks pose less risk but also lower returns.

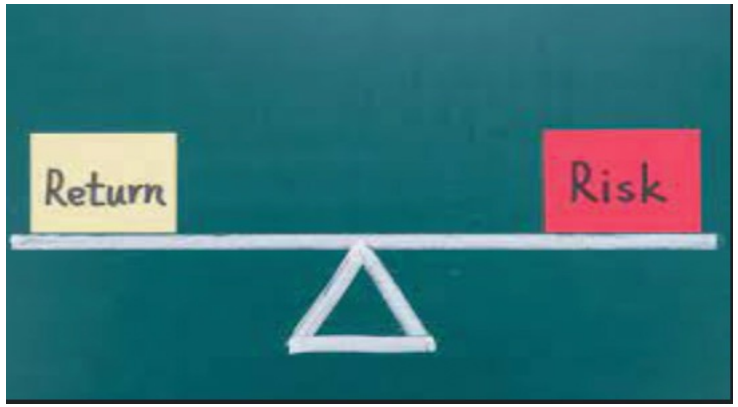
- **As seen earlier, Beta is a component of the Capital Asset Pricing Model, which calculates the cost of equity funding and can help determine the rate of return to expect relative to perceived risk.**

- **The Stocks on the right which have Beta values more than 1 are more volatile than market index ('Close' - S&P 500) hence riskier and vice versa**

	Close
amer_air	1.348402
alsk_air	1.245418
hwi_air	1.247685
cred_sui	1.380244
deut_bk	1.540307
gld_schs	1.301164
bsh_hc	1.334568
jnj	0.657456
mrk	0.731885
apple	1.061613
amazon	0.995492
google	1.011770
Close	1.000000

EXPECTED RETURNS – HOW MUCH THE STOCK WILL YIELD?

- Based on CAPM and the Beta values calculated, the Expected Returns of each Stock is calculated as shown
- Expect a few stocks such as Merck, Johnson & Johnson and Amazon most of the Stocks will yield a high Return in comparison to the Market Index ('Close' – S&P 500) of 13.95%
- We have 2 measures 1.Beta Value and 2.Expected Returns using which we can select the Stocks to invest. Thus, here the CAPM method has come handy in Stock Selection to form the portfolio



amer_air	18.817709
alsk_air	17.381078
hwi_air	17.412699
cred_sui	19.261898
deut_bk	21.494786
gld_schs	18.158734
bsh_hc	18.624721
jnj	9.179007
mrk	10.217297
apple	14.816995
amazon	13.894612
google	14.121698
Close	13.957500

STOCK SELECTION – PORTFOLIO CREATION

- The Tech Giant stocks - Apple, Amazon and Google have Beta values of around 1 which means that they aren't Highly volatile as the market. Also, they will be following the same trend as the Market Index S&P 500.
- Other stocks such as Johnson & Johnson, Merck and Bausch HC have relatively low Beta value are less risky as they are not volatile. But they also provide lower Returns.
- Though the Aviation and Finance Industry stocks offer very high Returns compared to others, their High Beta value makes them riskier to choose. Considering the Risk Appetite of the Investor the High-Risk and High Return stocks are being avoided.
- The Stocks highlighted have been selected to form the portfolio creating a balanced and promising Portfolio.

Stocks	Beta	Exp. Return
American Airlines	1.34	18.81
Alaskan Airlines	1.24	17.38
Hawaiian Air	1.24	17.41
Credit Suisse	1.38	19.26
Deutsche Bank	1.54	21.49
Goldman Sachs	1.3	18.15
Bausch HC	1.33	18.62
Johnson & Johnson	0.65	9.17
Merck	0.73	10.21
Apple	1.06	14.81
Amazon	0.99	13.89
Google	1.01	14.12

MONTE-CARLO SIMULATION – TO FIND THE BEST PORTFOLIO

- Monte Carlo methods, or Monte Carlo experiments, are a broad class of computational algorithms that rely on repeated random sampling to obtain numerical results. The underlying concept is to use randomness to solve problems that might be deterministic in principle. (Source Wikipedia)

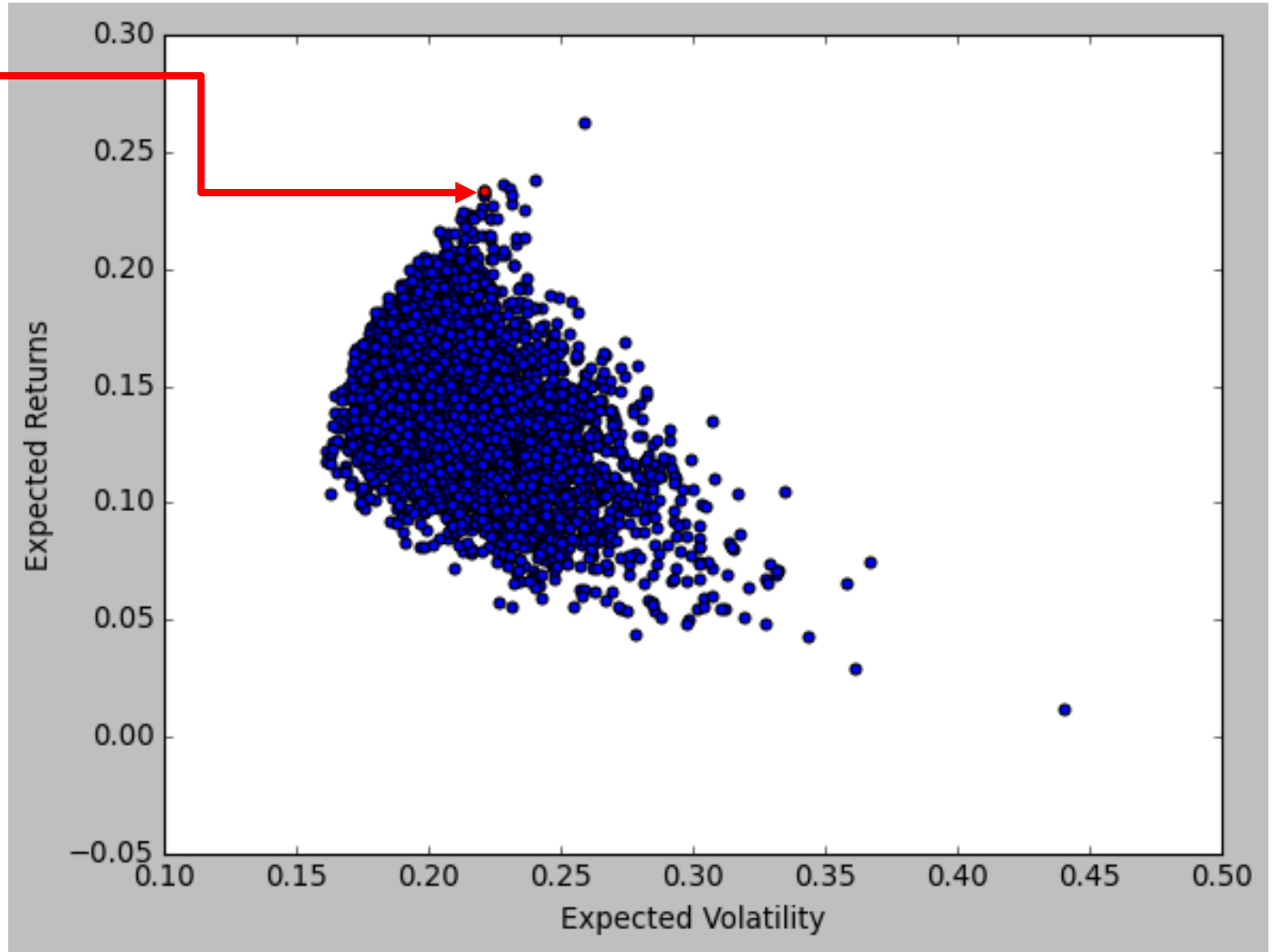
- Though the investment amount is not known, based on the stocks suggested above the Monte-Carlo Simulation will give the best Volume of each Stock in the portfolio

- The Simulation is run to find out the best volume of each Stock in the portfolio by picking stocks at different volumes in random and plotting them against Volatility and Return of the portfolio

- Sharpe Ratio a Financial Measure is used as a measure to find the Best Portfolio

THE BEST PORTFOLIO

Each dot in the scatter plot represents a portfolio. After 5000 runs of simulation, the best is highlighted in Red.



The Best portfolio is as follows:

1. Bausch HC - BHC - 1.1%
2. Johnson & Johnson - JNJ - 10.7%
3. Merck - MRK - 3.5%
4. Apple - 32.5%
5. Amazon - 40.4%
6. Google - 11.6%

Expected Return of the Portfolio – 26.2%